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Advanced Utility Simulation Model
User's Guide (Version 3.0)

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ADVANCED UTILITY SIMULATION MODEL
USER'S GUIDE
(VERSION 3.0)

by

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ABSTRACT

The Advanced Utility Simulation Model (AUSM) is one of four stationary source emissions and control cost forecasting models developed by the Air and Energy Engineering Research Laboratory for the National Acid Precipitation Assessment Program. The AUSM projects air emissions of SO_2, NO_x, and particulates from electric utilities; forecasts changes in emissions resulting from reduction initiatives; and assesses the resulting financial and economic impacts of these initiatives on utilities and consumers. Model results, derived from a 1980 baseline, are generated by state for each year from 1980 to 2009.

The AUSM was developed from the modules delivered to EPA by the Universities Research Group on Energy (URGE) in 1984. This report describes the procedures for operation of the entire integrated model that has been constructed from URGE modules by the Science Applications International Corporation (SAIC) research team. The SAIC research team includes E.H. Pechan & Associates, Inc. (PECHAN) and RCG/Hagler, Bailley, Inc.

The AUSM (Version 3.0) is available with all necessary software for remote terminal access and operation at the EPA National Computer Center (NCC). For information on operating the model at the NCC, contact the National Technical Information Service (NTIS). Information can be obtained from Lois Grooms, NTIS, 5285 Port Royal Road, Springfield, VA 22161, telephone 703/487-4808.

A magnetic tape copy of AUSM Version 3.0 is also made available for distribution with this report series. The tape is identified by the number EPA-600/8-88-071/ and can be obtained from NTIS. Version 3.0 of the AUSM model requires use of linear programming (LP) software packages. LP software in the public domain is included on the magnetic tape for operation of the state level model. However, the national loop of the UASM is currently programmed to use purchased LP software (MPS III available for purchase or lease from the Ketron Corporation, MSS Division, 1700 North Moore Street, Arlington, VA 22209, telephone 703/558-8700, not included on the magnetic tape. The model can be reprogrammed to use other LP software products or a smaller custom-built LP program if desired.

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ABBREVIATIONS

ITEM	DESCRIPTION
AFUDC	Allowance for funds used during construction
AUSM	Advanced Utilities Simulation Model
Btu	British thermal units
Ca/S	Calcium to sulfur ratio
CF	Capacity factor
FIPS	Federal Information Processing Standard
HHV	Higher heating value
ITC	Investment tax credit
KWh	Kilowatt hours
LDC	Load Duration Curve
LIMB	Lime Injection Multi-stage Burner
MMBtu	Million British thermal units
MPMS	Multi-period, Multi-state
MW	Megawatts
MWh	Megawatt hours
NSPS	New Source Performance Standard
SAIC	Science Applications International Corporation
SO_2	Sulfur dioxide
NO_x	Nitrogen oxides
RNSPS	Revised New Source Performance Standard
SAS	SAS Institute, Inc., developer of a series of data analysis and management packages for the computer
SIP	State Implementation Plan
URGE	Universities Research Group on Energy
XMP	FORTRAN based linear programming package

1 INTRODUCTION

The Advanced Utility Simulation Model (AUSM) User's Guide contains step-by-step instructions for running a basic simulation on the U.S. Environmental Protection Agency's (EPA's) IBM 3090 mainframe computer system using the default data set. Section 6 provides more detailed instructions for users wishing to run more complex scenarios. These users will need a more extensive familiarity with the AUSM, the Time Share Operating system (TSO) QED editor, and IBM Job Control Language (JCL).

This guide also assumes familiarity with AUSM. Users should read the analytical, program, and systems documents listed in the references.

Default data sets provided with the model constitute a hypothetical input scenario for test purposes only. They do not represent a view of the future adopted by the National Acid Precipitation Assessment Program (NAPAP) or by the Environmental Protection Agency (EPA). Default data and scenario assumptions should be used as a training tool and as a starting point for construction of scenarios of interest to the user.

A variant of the interim base case can be run by modifying inputs to the AUSM for any state or region. It is the user's responsibility, however, to ensure that all such changes are consonant with AUSM assumptions and conventions. It is strongly recommended that before attempting changes to data or switch settings, users copy the default data sets and modify only the copy in order to preserve a backup of the original data.

1.1 How To Use This Guide

Analysts may conduct both default and non-default model runs using the AUSM Users' Guide. General procedures that would apply to all AUSM runs (default and non-default scenarios) are described in sections 2 through 5. Using the model to perform non-default simulations (eg. SIP rollback option, permit trading, etc.) would entail more modifications to AUSM settings including: editing data files, modifying output specifications, revising JCL and CLIST's, or some combination of all of these. A list of scenario options the user may implement in AUSM is provided in Table 1. Implementation of these more complex scenarios is described in section 6.

1.2 Conventions Used in the Guide

The following conventions have been adopted throughout this guide:

> **ZZZ** signals the user to key in his user ID.
>
> **ssssssss** indicates that the user should enter a one to eight letter scenario name.

User responses to system prompts may be typed in upper case or lower case characters. Once a given scenario name has been specified, this same name should be consistently used throughout all phases of the model execution. Finally, for ease of readability, user responses throughout the manual have been underlined.

Whenever jobs are submitted to the IBM system, the system responds with the following message:

JOB (job number) SUBMITTED

A new job number is provided for each job submitted to the system. Please write the number down for later reference. Instructions given elsewhere in this guide require the job number.

Table 1. AUSM Scenario Options

I.	EMISSION LIMIT REGULATIONS SCENARIO
	A. Unit-level Emissions Level Changes
	B. State Emissions Limitations
	C. State SIP Emissions Rollback
II.	FINANCIAL PARAMETERS
	A. Corporate Tax Rate
	B. Investment Tax Credits
	C. Depreciation
	D. Cost of Capital
III.	FUEL-RELATED OPTIONS
	A. Coal
	B. Nuclear Construction Moratorium
	C. Fuel Costs
IV.	EMISSIONS CONTROL TECHNOLOGY PARAMETERS
	A. Cost Parameters
	B. Technology Parameters
V.	UTILITY SYSTEM OPERATING PERFORMANCE AND BEHAVIOR
	A. Unit Lifetimes
	B. System Availability
	C. System Reserve Margins
	D. Demand Growth Rates
VI.	LEAST COST FUEL AND TECHNOLOGY COMBINATIONS

Detailed information regarding AUSM file management is provided in supplemental appendices. A complete listing of the JCL, load modules/source code, input data files, and output files associated with each CLIST is presented in Appendix A. Appendix B contains brief definitions of files used and created during an AUSM simulation. Although all files used to run the AUSM are currently on the AUCC account, the AUSM can be executed from any account granted access to AUCC.

Where possible, AUSM data is stored in a partitioned data set (PDS). PDS names and the names of individual PDS members are given in following chapters.

2 LOGGING ONTO THE SYSTEM

The AUSM is currently maintained on the U.S. Environmental Protection Agency National Computer Center system (EPA/NCC). Running the AUSM using the IBM TSO involves four phases: logging on to TSO, compiling source code to create load modules, executing the National Loop, and executing the State Model. This section describes the log on procedure.

Telephone numbers for dialing in to NCC are not provided in this guide. These should be obtained from NCC together with authorization to use the system. If problems arise during the logon procedure users may consult the EPA Help Center at (800) 334-2405.

For readability ease, computer prompts in this manual are CAPITALIZED and user responses are **CAPITALIZED IN BOLD LETTERS AND UNDERLINED**. A step-by-step outline of current system prompts and acceptable user responses is given below; however, users should consult with the EPA/NCC staff to ensure that the logon procedure has not changed since this document has been written.

PLEASE ENTER ONE OF THE FOLLOWING SELECTIONS:	**IBMPSI**
SELECT LOCATION:	**A**
TYPE IN USER ID:	**ZZZ**
TYPE IN PASSWORD:	**ssssss**
ENTER ACCOUNT NUMBER:	**AUCC**
SELECT APPLICATION:	**$EPATSO**
SELECT FIMAS ID:	**AUSMP**

The password (shown above as **ssssss**) must begin with a character. In addition, the password must have no fewer than three and no more than eight characters. Also, users should consult the appropriate EPA project manager about establishing a unique four letter account number.

A series of messages will appear on the user's screen at this point regarding software upgrades, scheduled system maintenance, etc. After these messages have completed and the flashing cursor is positioned at the bottom of the screen, the user must enter the FIMAS ID: **AUSMP**. Users will need to consult an EPA project manager to establish their own FIMAS ID. Execution of AUSM macros may begin after receiving the TSO **READY** prompt.

3 PROGRAM COMPILATION

Source code for both the National Loop and State Model must be compiled in the first stage of an AUSM simulation. This CLIST explains how to create load modules for all source code used to execute the AUSM.

Step 1:

Check to see if the AUSM load modules already exist by typing the following in TSO:

```
LISTC L(zzzAUCC.COMPILED)
```

If the following files list to the screen, skip the rest of this section and continue with Section 4 (National Loop Execution):

```
COMPILED.COAL.RUNBK.PDS
COMPILED.MPMS.RUNBK.DTFM.DATAFORM
COMPILED.MPMS.RUNBK.TABGEN.PDS
COMPILED.AUSM.RUNBK.PDS
```

Step 2:

Execute the compile CLIST and respond to the following prompt:

```
EXEC 'zzzAUCC.RUNBK.MACRO.PDS.CLIST(COMPILE)'
```

Response:

```
Enter your 3-letter user ID:  ZZZ
```

Tracking submitted jobs involves several steps. First, record the job numbers associated with the execution of this CLIST for later use. When the jobs have completed execution, be sure that each job step has been executed with a condition code of zero (CC: 0000). Non-zero condition codes in job steps may or may not indicate the existence of program errors. It is the user's responsibility to evaluate the severity of error (if any) and to take corresponding corrective measures. Assessing the status of a given job may be performed by entering the following commands:

```
QUEUE
FETCH job#
FIND 'CC:' ALL
END
```

4 NATIONAL LOOP EXECUTION

Conventional execution of an end-to-end AUSM run requires running the National Loop before running the State Model. However, State Model runs may be initiated using either previous National Loop runs as inputs or purely exogenous information. Though not described in this guide, instructions for invoking these options are discussed in The State-Level Advanced Utility Simulation Model: Analytical Documentation (1) and in The State-Level Advanced Utility Simulation Model: Program Documentation (2).

4.1 Deciding To Run The National Loop

Analysts face tradeoffs in deciding whether to use National Loop outputs as inputs to the State Model or whether to use exogenous information to conduct a State Model simulation. While using National Loop outputs as inputs to the State Model ensures consistency among scenario assumptions, this approach does entail performing at least one over-night simulation requiring up to 140 minutes of CPU time. On the other hand, conducting State Model runs using exogenous transfer information can be performed very rapidly, but there will be a consequent loss in the ultimate comparability of National Loop and State Model results. Analysts need not address this tradeoff in performing the default run outlined in this guide. This issue may be relevant, however, if analysts wish to conduct non-default analyses.

Where time and/or computer resources are important, the State Model can usually be run using previous National Loop outputs if there are no major scenario differences. For example, a sensitivity study of changes in SO2 emissions caused by different boiler retention assumptions can be done without rerunning the National Loop. On the other hand, a study of sensitivity to assumptions about the growth in demand for electricity usually does require National Loop runs. In general, the National Loop should be run before the State Model if the analyst feels that there will be a large change in the demand for different coals.

If the user wishes to provide his/her own assumptions about coal prices, interstate electricity transfers, and capacity additions, the National Loop does not have to be run. Further, a National Loop run may always be modified to suite user needs.

4.2 Execution Steps

After successfully creating load modules as described in the previous section, two more CLIST macros, MPMS1 and MPMS2 (see Appendix A), are executed in the next phase of a model run. MPMS1 submits the JCL to execute the multi-period, multi-state module (MPMS) and the coal supply/cost equilibrium module. MPMS2 then submits the JCL to create MPMS summary reports and input data files for execution of the State Model, described in Chapter 5.

Step 1:

Execute the National Loop/coal convergence CLIST and respond to the following prompts:

```
EXEC 'zzzAUCC.RUNBK.MACRO.PDS.CLIST(MPMS1)'
```

Response:

```
Enter your 3-letter user ID:  ZZZ
Enter 1-8 letter scenario ID:  ssssssss
Enter beginning iteration # (min of 1):  1
Enter end iteration # (max of 10):  5
```

Note that the beginning iteration # generally starts with 1. Record the job number associated with the execution of this CLIST. When the jobs have completed execution, check to make sure each job step was executed with a condition code of zero (CC: 0000) by entering the following commands for each job:

```
QUEUE
FETCH job#
FIND 'CC:' ALL
END
```

Step 2:

The convergence file(s) [zzzAUCC.ssssssss.COAL.IT**.CONVRPT] produced for each iteration should be inspected to see if convergence has been achieved. A nonconvergent run will contain disequilibria in the coal supply and coal demand markets between 1980 and 2020. Disequilibrium for a default simulation exists when the differences in coal demand and coal supply markets exceed ten percent in absolute value. To see if the convergence reports have been produced, enter the following command:

```
LISTC L (AUCC.ssssssss.COAL.IT**.CONVRPT)
```

Use the files to see which one most completely satisfies user-specified convergence criteria.

```
QED '(zzzAUCC.ssssssss.COAL.IT**.CONVRPT)'
VERIFY ON
RENUM 1 1
(carriage return)
```

When the user is finished reviewing each convergence file, type **END NOSAVE** to return to the READY prompt. It is the user's responsibility to interpret this important report. Typically, the National Loop converges in about six iterations for all states which are significant coal consumers and for years prior to 2010. It is not unusual to find disequilibria in states which are not significant consumers of coal and/or for years after 2010. Normally, this is not a cause for concern because minor consumers tend to be price takers and because the State Model does not run past 2010.

Step 3:

If the convergence test is not satisfactory for purposes of the analysis which the user is conducting, repeat Step 1 with the following changes:

(1) define the new Beginning Iteration # by incrementing the previous End Iteration # by one.

(2) set the new End Iteration # to the desired number of iterations. No more than ten iterations should be considered.

Once the CLIST in Step 1 has been re-executed, continue with Step 2.

Step 4:

Upon convergence, execute the reports CLIST and respond to the following prompts:

```
EXEC 'zzzAUCC.RUNBK.MACRO.PDS.CLIST(MPMS2)'
```

Responses:

Enter your 3-letter user ID: **ZZZ**
Enter 1-8 letter scenario ID: **ssssssss**
Enter convergence iteration #: X (where, X = 1 to 10)

The convergence iteration number is typically 6, 7, or 8. However, selection of an iteration is normally based on a review of the convergence report discussed above. One common criterion is to select that iteration for which the fewest number of states exceed user-specified convergence tests for the fewest number of years. Particular attention should be paid to states which are large coal users and to years earlier than 2010.

Record the job number associated with the execution of this CLIST. When the jobs have completed execution, check to make sure each job step was executed with a condition code of zero (CC: 0000) by entering the following commands:

```
OUEUE
FETCH job#
FIND 'CC:' ALL
END
END SAVE
```

Note that the E9 report files, which contain information on interstate transfers and the price of purchased power, are adjusted exogenously for interregional power transfer between West Virginia (region 7 -- East Central) and New Jersey (region 3 -- Mid Atlantic), since the National Loop does not model interregional transfers. The two Fortran programs are executed to make adjustments: zzzAUCC.SOURCE.MPMS.RUNBK.PDS -- members WVXFER and NJXFER. These programs assume West Virginia exports 27,409 kWh to New Jersey. However, due to the estimated 6% line loss, New Jersey realizes an import level of 25,765 kWh. These programs are included as part of the MPMS2 CLIST executed above.

5 STATE MODEL EXECUTION

Execution of the State Model is the final step in an AUSM run. The State Model produces a variety of user-specified reports, each of which is described in the analytical (1), program (2), and system design documentation (3).

5.1 Running the State Model

The National Loop provides coal prices, interstate transfers, capacity expansion plans, and a number of parametric inputs to the State Model. Simulation of utility operations for each of the 48 contiguous states is done by the State Model. A series of macros executes the State Model using National Loop output.

Two CLIST macros are executed in this phase. The first CLIST submits the JCL to create a modified announced inventory and to execute the State Level model for all thirteen MPMS regions. The second CLIST submits the JCL to summarize the results of all thirteen regions into a national report.

5.2 Execution Steps

The following steps execute the State Model. It is assumed that users have entered all data not passed from the National Loop and specified desired reports.

Step 1:

Execute the state-level CLIST and respond to the following prompts:

```
EXEC 'zzzAUCC.RUNBK.MACRO.PDS.CLIST(AUSM1)'
```

Responses:

```
Enter your 3-letter user ID:    ZZZ
Enter 1-8 letter scenario ID:   ssssssss
```

Output summary tables are written to the fetch queue. Therefore, it is especially important to record the job numbers submitted by this CLIST for each of the thirteen regions. When the jobs have completed execution, check to make sure each job step was executed with a condition code of zero (CC: 0000) by entering the following commands:

```
QUEUE
FETCH job#
FIND 'CC:' ALL
END
```

Step 2:

A hard copy of the output summary tables produced from Step 1 can be obtained by printing each job from QUEUE. To enter the QUEUE mode, enter the following command:

```
QUEUE
```

Print each region's summary output by executing the following command for each region's job number:

```
ROUTE job# bin#
```

Exit QUEUE:

```
END
```

Step 3:

The SAS national report (SASNAT) writer aggregates state-level results to MPMS-defined regions. SASNAT results are summarized by category, region, and year. Some of the categories of information included in this file are: demand, generation, fuel use, fuel prices, capacity factors, capacity additions, and emissions. The financial and coal movement reports are the only regional level results which cannot be aggregated nationally. Execute SAS national report writer CLIST and respond to the following prompts:

```
EXEC 'zzzAUCG.RUNBK.MACRO.PDS.CLIST(AUSM2)'
```

Responses:

Enter your 3-letter user ID: ZZZ
Enter 1-8 letter scenario ID ssssssss

The output summary tables are written to the fetch queue. Record the job number associated with the execution of this CLIST. When the jobs have completed execution, check to make sure each job step was executed with a condition code of zero (CC: 0000) by entering the following commands:

```
QUEUE
FETCH job#
FIND 'CC:' ALL
END
```

Step 4:

To obtain a hard copy of the output summary tables produced from Step 3, the job must be routed by entering the following commands:

```
QUEUE ROUTE job# bin #
END
```

6 SCENARIO OPTIONS

AUSM lets analysts conduct different non-default simulations by either strategically selecting certain control switches in the State Model Scenario Directives file, by changing the values of input variables in the AUSM data bases, or some combination of both of these operations. The potential number of permutations from altering these switches and data bases is vast; so only the most frequently used scenario options are fully described in this section. Familiarity with the model operations manual (4) and the Description of the National Loop of the Advanced Utility Simulation Model (5) will allow users to experiment with sensitivity analyses.

6.1 Data Files

AUSM's data files are grouped as National Loop files and as State Model files. Although files are passed between the two components, they are not shared, making State Model stand-alone runs possible.

6.1.1 National Loop Driver Files

National Loop inputs are contained in a set of driver files. As documented in Advanced Utility Simulation Model, Description of the National Loop (Version 3.0) (6), there are four kinds of file:

- one scenario driver file, which contains data applying to all regions in the scenario being run and identifies each region in the scenario,
- one regional driver file for each region, which contains data applying to all states in the region and identifies each state in the region,
- one regional technology file for each region, which contains cost and performance data for the generating technology categories defined for the region, and
- one state driver file for each state in each region, which contains state-specific information.

Driver files control the linear program (LP) executed in MPMS by specifying decision variables, objective function coefficients, and constraints. Policy variables, such as state- or region-specific emissions constraints, are also elements of the driver files. In short, every piece of data needed to control MPMS is found in the driver files.

Default driver files are members of a PDS, "zzzAUCC.DATA.MPMS.RUNBK.PDS". Individual members are:

Driver File	PDS Member Name[1]
Scenario Driver File	SCEN
Regional Driver File	RDFnn
Regional Technology File	RTFnn
State Driver File	SDFaa

Thirteen regions are currently used as default power pools. However, the user may specify any configuration of regions providing that no region contains more than seven states. AUSM recognizes regions and states as sets of data. Therefore, any internally consistent data set may be used in defining a state or a region. Ensuring such consistency is the user's responsibility. Default data sets supplied with the model are consistent.

Scenario Driver File

Key general assumptions about the AUSM modelling framework are contained in this file. For example, the number of permissible time periods and the names and number of regions are also defined in the Scenario Driver file. The following National Loop information is determined in this file:

- beginning baseline year,
- time period definitions,
- state/regional emission limit switch,
- line loss fraction,
- capital cost of distribution equipment (1980 dollars/Kw), and
- names and number of user-defined regions.

---

1 "nn" following a regional file indicates the region number (1 - 13). "aa" following a state file name indicates the standard two character abbreviation for the state to which the file applies.

Regional Driver File

Primary purposes of this file include the following: determine which technology categories will be included in each AUSM region; map out how states are to be segregated into regions; establish target build mixes[2] (optional); set system reserve margins; and construct regional emissions limits (optional). Parameters defined in this file are:

- o region type, scrubber penalty, and scrubber removal efficiency,
- o technology category definition,
  - -- technology names/ID's
  - -- fuel ID's
  - -- scrubbing options/regulation and emission rates
  - -- heat rates
  - -- target build mix ratios
- o reserve margins and scrubber capital costs, and
- o regional emissions limits (if applicable).

One regional driver file exists for each region selected. The default version of the AUSM contains 13 regions.

Regional Technology File

Regional Technology files present cost and performance information about each of the generating technologies defined for a given region. Ten technology categories have been defined for each region in the default version of the AUSM. Moreover, technology category definitions can vary from region to region. All Regional Technology files have the same structure, though some information may vary from region-to-region depending on the technology option under consideration. These files contain the following information:

- o technology category ID's,
- o fuel ID's, scrubbing options, and maximum emissions standards,
- o planned and unplanned outages,
- o maximum and minimum capacity factors,
- o heat rates, plant lifetimes, and construction lead times, and
- o capital costs, fixed O&M costs, and variable O&M costs.

---

2 Target build mixes are optional constraints which allow users to model policy decisions which encourage (discourage) certain generating technologies over others. One example policy might be a region in which Installed Gas Combined Cycle (IGCC) represents 50 percent of the generating capacity by, say, 2010. Note, these constraints are only an option -- they need never be invoked.

Each region defined in the Regional Driver file is accompanied by one Regional Technology file.

State Driver File

Modelling information unique to a given state is defined in the State Driver files. Disaggregated state-specific data may be incorporated into the structure of these files. These data include:

- base-to-peak ratios and load factors,
- 1980 demands and demand growth rates,
- state emissions limits (if applicable),
- upper and lower capacity mixes,
- state discount rates,
- fuel, capital cost, fixed O&M, and variable O&M escalation rates,
- capital and O&M cost multipliers, and
- annual generating and scrubbed capacity.

Only one state is represented by each file -- there are a total of 48 State Driver files.

6.1.2 State Model Data Files

Users wishing to run scenarios differing from the default scenario will need to modify data elements of one or more of the following files. Each is a member of a PDS named "zzzAUCC.DATA.AUSM.RUNBK.PDS". The member name is shown below:

File	AUSM Designation	PDS Member Name[3]
Scenario Directives	E8	SCENRnn
Pollution Control Technology	E3	POLLUTE
Capacity Planning	E2	PLANRnn
Finance	E4	FINANCE
State Emissions Limits	n/a	STEMAX

The files containing inventories of existing and announced units are found in a PDS called "zzzAUCC.DATA.INVENTORY.RUNBK.PDS". The member name is shown below:

---

3 "nn" appearing in a PDS member name refers to the region number. There are 13 default regions, numbered 1 through 13.

File	AUSM Designation	PDS Member Name
Unit Inventory	E5	EXISTING
Announced Unit Inventory	E5A	ANNOUNCE

Unit and Announced Unit Inventories

Physical and operational data on electric utility generating units larger than 50 megawatts are contained in the Unit Inventory and the Announced Unit Inventory. The Unit Inventory contains information about units which were operating prior to 1981 while the Announced Unit Inventory contains information about units which were planned to become operational after 1980. These data bases are subsets of the NAPAP Utility Reference File (NURF). Information contained in these files includes:

- geographical location and plant name,
- boiler size and operating characteristics,
- on-line and retirement dates,
- technology type,
- primary and secondary fuel characteristics (including price), and
- emission control regulatory categories and standards.

Scenario Directives File

Users may conduct a variety of sensitivity analyses by manipulating both global and state-specific model parameters in this file. While adjustments to global parameters affect all states in a region, changes to state-specific parameters affect only the states for which options have been invoked. Global parameter assumptions are made about the following:

- demography,
- capacity planning,
- cost of capital,
- methods of model operation,
- pollution control options,
- economic growth indices,
- fuel price indices, and
- demand.

At the state-level, users may manipulate control technology parameters, emission/cost constraints, and capacity planning assumptions. Specific options

within each of these categories are described more fully in the AUSM model operations document (4).

Pollution Control Technology File

Default assumptions, specified exogenously by the user, regarding pollution control technology data are contained in the Pollution Control Technology File. Only national-level data are defined in this file. File attributes include permissible control technology options, pollutant retention levels, equipment costs, retrofit factors, and construction requirements for SO_2, NO_x, and TSP control devices.

Capacity Planning File

The Capacity Planning file consists of three parts. The first contains technology-specific, regional-level data for electric power plants. These include:

- plant availability,
- capacity factor,
- heat rate,
- construction period,
- plant life,
- capacity,
- total construction costs, and
- nonfuel O&M costs.

The second part contains technology-specific, national level construction cost spread data. The final part contains transmission, distribution, and state-level plant cost data.

Finance File

The finance data file contains information on depreciation, tax schedules, and tax credits at the national and state levels. Additional state-level data include information on rate of return, capitalization, and base year values associated with capital costs.

6.2 Running Non-Default Scenarios

The number of non-default scenarios which can be studied using AUSM is limited only by the user's resources and imagination. New scenarios are created by changing data inputs, switch settings, or both; running different regions or states in special ways; or modifying model logic by changing the actual source code. The following sections define some of the more common scenarios.

6.2.1 Emission Limits Scenario Options

The default scenario defines both emission limits and regulatory requirements at the unit level and allows control strategies to be determined on an economic basis. NSPS, RNSPS, and SIP regulations are recognized. No cap is put on total emissions within any state. Scenario and data files can be altered to do any of the following:

- change generating unit emission requirements after a user-specified year,
- put a state emissions limitation into effect after a given year,
- require SIP units to rollback emissions by a user-specified percentage, or
- change averaging times for measuring emissions.

The following paragraphs describe the data file changes required to run these scenarios.

Unit-Specific Emission Limit Changes

Data fields exist within the unit inventory file (E-5) which define new standards and compliance years for SO_2, NO_x, and TSP emissions. The limitation is that new standards can be defined only once during the simulation time period. Also, random changes to the inventory must be done using a file editor. If new standards are to apply to an identifiable group of units, this can be done by adding code to the UNCHNG subroutine within the Pollute Module in the State Model. This would require recompiling the State Model once these coding changes are complete.

State Emissions Limitations

Flexibility to set emissions caps at the unit, state, or regional level has been built into AUSM. State-level emissions caps may be set for SO_2, NO_x, and TSP emissions in the State Model, while both state-specific and regional SO_2 emissions caps may be applied to the National Loop. If a state or regional emissions constraint is adjusted in the National Loop, a corresponding change should be made to the appropriate State Model data file(s).

Invoking State Model emissions constraints is a straightforward procedure. To construct emissions constraints for SO_2, NOx, or TSP, state-specific variables 528, 529, and/or 530 in the Scenario file must be adjusted, respectively. Newly set emissions caps will apply to all years in a simulation. These variables may be set independently or as a group. Regional constraints are set up by constraining some or all the states in a region.

Configuring National Loop simulations constrained by SO_2 emissions is also fairly simple. The emissions constraint switch in the National Loop Scenario file is set equal to 1 to employ state SO_2 limits; and it is set equal to 2 for regional limits. State limits are set by altering the default emissions values found in the State Driver file emissions cap fields. Users may invoke caps for any of the MPMS-defined time periods (which may also be modified). To set regional limits users need to modify the Regional Driver file. The structure of both of these files is explained more fully in the Description of the National Loop of the Advanced Utility Simulation Model (5) report.

State SIP Emissions Rollback

Uniform SO_2 emissions rollbacks for each SIP unit in the Unit Inventory may be performed using AUSM. To employ this option several parameters in the State Model Scenario file need to be adjusted. Global scenario variable 79, the Pollution Control Management Switch, must be set to one to signal the model to execute a rollback scenario. In addition, global scenario variable 80 needs to be converted from its default value of 9999 to the year in which the user wants the rollback option to become effective. Lastly, state-specific scenario variable 541 must be changed to the fractional value of the desired reduction in emissions (ie. .50 for a fifty percent reduction). The rollback takes effect starting in the year specified in scenario variable 80 and last to the end of the simulation.

Changes in Averaging Time

The AUSM allows users to select several different sulfur "relative standard deviation" (RSD) averaging times for old and new units. State-specific scenario variables 512 and 513, the respective switches for old and new units, may be modified in the State Model Scenario Directives file (E-8). Users have three RSD averaging options to choose from: (1)24 hours, (2)30 days, or (3)365 days. The "old unit" default is option 3 (365 days) and the "new unit" default is option 2 (30 days). Equivalent National Loop averaging variables do not exist.

6.2.3 Changing Financial Parameters

Users can analyze effects of changing default assumptions about financial behavior by making a series of data file adjustments and source code revisions. A few of the parameters which might be altered include corporate tax rates, depreciation schedules, investment tax credit provisions and cost of capital calculations. Procedures for running these are outlined below.

Corporate Tax Rate

Maximum federal corporate tax rate variables may be adjusted by AUSM users to meet specific scenario needs. The AUSM Financial Module has recently been updated to account for a changes in the maximum federal corporate tax rates. Tax rates for the years 1980-1986 and 1987 have been hardwired into to the source code at 46 percent and 40 percent, respectively. Modifying these parameters would require users to recompile the source code and create another AUSM load module before executing State Model runs. The federal corporate tax rate after 1987 is set be altering the value of item identifier number 90 (variable FTXR) in the Finance data file. Between 1988 and the end of the simulation (2009) the federal corporate tax rate is assumed to be equal to 37 percent.

Investment Tax Credit

Default assumptions about Investment Tax Credits (ITC's) include their removal after 1987 as provided by recent tax code changes. However, alternative assumptions can be made. Provisions for ITC's may be changed by varying the values of item identifiers 91-120 in the Finance data file. The default version

of the AUSM allows a 50 percent tax credit (so the ITC variable is set to 1.5 in Data Group 60) on capital expenditures incurred from 1980 to 1986 and no tax credit for the following years.

Depreciation

Effects on utility financial performance due to changing depreciation assumptions can be studied by changing default depreciation assumptions. Both asset tax lives and depreciation schedules can be changed. Prior to 1986, asset tax lives (item identifiers 76-89) and depreciation schedules (item identifiers 32-61) are located in the Finance data file. After the implementation of the 1986 tax code changes, however, asset tax lives and depreciation schedules are determined in the Financial Module source code. Assets which previously had 10 and 15 year tax lives are automatically given 15 and 20 year tax lives in the revised Finance Module source code. In addition, post-1986 asset depreciation schedules are set in data statements DP152 and DP201 at the bottom of the Finance Module source code.

Cost of Capital

Sensitivity of financial performance to changes in the cost of capital can be conducted. To perform these kinds of studies, it may be necessary to change values in the Scenario Directives files and the Financial Module source code. Cost of capital premiums, based on interest coverage ratios reported in the AUSM financial summary results, are set by changing the values in the COV2LV and COVADJ data statements in the Finance Module source code. The following global scenario variables representing nominal interest required for different types of debt may be modified to correspond to user scenario specifications in the Scenario Directives files: new debt (GETSCN 55), desired preferred equity (GETSCN 56), and desired common equity (GETSCN 57). The default AUSM values for these variables are 13 percent, 13 percent and 15 percent, respectively.

6.2.4 Fuel Options

Several fuel-related options may be employed by adjusting variables in the State Model Scenario file. Some of the parameters contained in this file which analysts may modify include: a local coal option, a nuclear unit moratorium option, and non-coal fuel price growth rate data.

Coal

The local coal option is a flag defining whether any coal or only state coal can be used. To invoke the local coal option, global scenario parameter 69 should be changed from 0 to 1 in the Scenario Directives file. The AUSM currently allows any coal to be selected.

Nuclear Construction Moratorium

Users may employ AUSM to assess the impacts of declaring a nuclear construction moratorium. To use this option, a state-specific moratorium end year (global scenario parameter 563) must be defined in the Scenario Directives file. In default mode, the AUSM prohibits construction of nuclear units (hence the switch is set to 1980).

Fuel Costs

Fuel price growth rates for oil, natural gas, and nuclear fuel may be adjusted by modifying the default values of global scenario parameters 91, 92, and 93, respectively. These rates are applied to the base rates defined in the alternate fuels data file (E-7). Default fuel prices in the E-7 file may also by adjusted by users. No fuel price escalation is assumed in the default version of AUSM.

6.2.5 Emissions Control Parameters

A number of studies can be conducted by changing data inputs which define emissions control options. These include data about cost and performance. Data changes are normally made on the regional level. However, state-specific changes can be made by defining single state regions.

Cost Parameters

Both the Pollution Control Technology data file (E-3) and the Scenario Directives files (E-8) contain emissions control cost parameters. Cost data in the E-3 file include bag replacement costs for fabric filters, unit direct cost for dry scrubbing systems, and indirect cost factors and retrofit factors for

wet and dry scrubbing systems, LIMB systems, fabric filters, and ESP's. For example, a scenario can be developed to vary LIMB retrofit factors in order to assess its affect on the future market penetration of LIMB technologies.

Reagent and land cost scenarios can also be developed by altering the E-8 file. The land cost parameter is 501; and, the reagents costs parameters are 502, 503, and 504 for wet FGD, dry FGD, and LIMB emission control systems, respectively.

Technology Parameters

Pollution control technology parameters are contained in the E-3 data file. Some of the parameters which apply to SO_2, NO_x, and particulate control devices that can be modified are:

- o sulfur retention in boiler[4],
- o construction lead times,
- o flyash fractions,
- o relative standard deviation (RSD) values,
- o default emissions factors for coal, oil, and gas units,
- o SO_2 removal fractions,
- o default capacity factors,
- o minimum FGD size,
- o various LIMB parameters, and
- o waste disposal options.

Changes to any or all of these parameters can create a number of new scenarios.

6.2.6 Utility System Operation

Utility system variables which users may define are plant lifetimes, unit availabilities, reserve margins, and demand growth rates. Utility system variable changes made to National Loop inputs should also be duplicated for corresponding State Model variables. Procedures to ensure this consistency for utility system variables are outlined below.

[4] Sulfur retention is defined as the percent SO2 which is retained in the boiler.

Unit Lifetimes

Users may shorten or prolong unit lifetimes by editing the appropriate National Loop and State Model data files. Though regional plant lifetimes may be specified, it is assumed in the default scenario that lifetimes are similar in each region. To ensure consistent results, plant lifetimes should be the same in both the National Loop Regional Technology files and the State Model Capacity Planning (E2) files.

System Availability Constraints

Users may modify the default maximum utilization for each plant category in each of the 13 regions by changing the default availability. To do this, adjust the maximum availability values for a given type of generating technology in both the National Loop Regional Technology files and the State Model Capacity Planning data files. Availability is defined in different units of measure in the National Loop and the State Model. Maximum plant availability is defined by the National Loop as total feasible hours out of the year that a unit is operational. The State Model, on the other hand, evaluates plant availability in terms of the fraction of a year that a unit is feasibly operational. For example, if the user wishes to model a situation in which gas-fired turbines are available for 3,000 hours/yr., the National Loop regional technology file shows an availability of 3,000 hours and the state model Capacity Planning file shows a maximum availability of 3000/8766 hours, or 0.342 (34.2 percent).

System Reserve Margins

AUSM users may adjust default, state-specific reserve margins. If desired, different reserve margins may be set for each state. National Loop reserve margin adjustments can be made to the appropriate field in the State Driver files. Default reserve margins in the Scenario Directives files can be modified by changing the state-specific scenario variable 565 to a value between 1 and 0.

Demand Growth Rates

The AUSM gives analysts the capability to vary demand growth rate assumptions in the National Loop and the State Model. National Loop demand growth rates are defined in the State Driver files. Demand growth rates for the State Model, however, are defined in the Scenario Directives files. Since the National Loop

and State Model time period definitions may be different, analysts should cautious in how they convert National Loop growth rates to State Model growth rates. The National Loop defines one growth rate for each time period, which may be one or more years long. State Model growth rates, on the other hand, apply to periods of one year. Accordingly, care should be taken to ensure that growth rates are consistent between the two components.

REFERENCES

1. Universities Research Group on Energy. Advanced Utility Simulation Model, Analytical Documentation, State Level Model (Version 1.0), EPA-600/8-88-071a, 1988.

2. Universities Research Group on Energy. Advanced Utility Simulation Model, Program Documentation, State Level Model (Version 1.0), EPA-600/8-88-071b, 1988.

3. Badger, Caroline J. and Ojalvo, Howard. Advanced Utility Simulation Model, Documentation of System Design, State Level Model (Version 1.0), EPA-600/8-88-071c, August 1988.

4. Universities Research Group on Energy. Advanced Utility Simulation Model, Model Operations (Version 1.0), EPA-600/8-88-071e, 1988.

5. Science Applications International Corporation. Advanced Utility Simulation Model, Description of the National Loop (Version 3.0), EPA-600/8-88-071h, 1988.

6. Science Applications International Corporation. Advanced Utility Simulation Model, Description of Modifications to the State Level Model (Version 3.0), EPA-600/8-88-071i, 1988.

APPENDIX AUSM CLIST MACROS

MACRO:COMPILE

```
/*************************************************************/
/*                                                           */
/* THIS MACRO COMPILES AND LINKS SOURCE CODE FOR             */
/* MPMS, THE COAL SIDE, AND THE STATE MODEL.THE              */
/* MACRO PROMPTS FOR USER ID AND CHECKS THE DATATYPE         */
/* AND LENGTH OF THE USER ID.                                */
/*************************************************************/
/*                                                           */
USER: WRITE ENTER YOUR 3-LETTER USER ID:
READ &S10
IF &DATATYPE(&S10)=CHAR AND &LENGTH(&S10)=3 THEN GOTO NEXT
WRITE ILLEGAL USER ID.
GO USER
NEXT: QED 'CPOASAI.JCL.COAL.RUNBK.PDS(CONVERG)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.COAL.RUNBK.PDS(CSA)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.COAL.RUNBK.PDS(EXPAND)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED'CPOASAI.JCL.COAL.RUNBK.PDS(NOD)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(DATAFORM)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(TABGEN)'
VERIFY OFF
```

```
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.AUSM.RUNBK.PDS(MAKELOAD)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.AUSM.RUNBK.PDS(WRITEX)'
VERIFY OFF
CHANGE * 9999 /ZZZ/&STR(&S10)/ALL
SUBMIT *
END NOSAVE
EXIT
```

```
MACRO:MPMS1

/*************************************************************/
/* THIS TSO CLIST PROCEDURE IS A MACRO WHICH EXECUTES        */
/* THE AUSM NATIONAL LOOP.THE MACRO FIRST PROMPTS THE        */
/* USER FOR INPUT DATA, INCLUDING USER ID, SCENARIO ID,      */
/* THE ITERATIONS WHICH SHOULD BE RUN.THIS INFORMATION       */
/* IS THEN SUBSTITUTED INTO THE IMAGE JCL FILE AND           */
/* SUBMITTED. THE SUBSITITUTION AND SUBMISSION IS            */
/* REPEATED UNTIL A JOB IS RUN FOR EACH ITERATION.THIS       */
/* MACRO CONTAINS EDITING COMMANDS UNIQUE TO THE QED         */
/* EDITOR AND MUST BE RUN UNDER THE TSO OPERATING            */
/* SYSTEM.THE MACRO IS EXECUTED FROM TSO BY TYPING EXEC      */
/* MACRO1.                                                   */
/*************************************************************/
/*                                                           */
/* MACRO PROMPTS FOR INPUT DATA AND SCREENS FOR CORRECT      */
/* CHARACTER TYPE, LENGTH, AND VALUE RANGE.                  */
/*                                                           */
USER:WRITE ENTER YOUR 3-LETTER USER ID:
 READ &S10
 IF &DATATYPE(&S10)=CHAR AND &LENGTH(&S10)=3 THEN GOTO SCEN
 WRITE ILLEGAL USER ID.
 GOTO USER
SCEN:WRITE ENTER 1-8 LETTER SCENARIO ID:
 READ &S0
 SET &L=&LENGTH(&S0)
 IF &DATATYPE(&S0)=CHAR AND &L>=1 AND &L<=8 THEN GOTO ITMIN
 WRITE ILLEGAL SCENARIO ID.
 GOTO SCEN
ITMIN: WRITE ENTER BEGINNING ITERATION # (MIN OF 1):
 READ &S1
 IF &DATATYPE(&S1)=NUM AND &S1>=1 AND &S1<=10 THEN GOTO ITMAX
 WRITE ILLEGAL BEGINNING ITERATION #.
 GOTO ITMIN
ITMAX: WRITE ENTER FINAL ITERATION # (MAX OF 10):
 READ &S2
 IF &DATATYPE(&S2)=NUM AND &S2>=1 AND &S2<=10 THEN GOTO NEXT
 WRITE ILLEGAL FINAL ITERATION #.
 GOTO ITMAX
/*                                                           */
/*************************************************************/
/*                                                           */
/* GO TO CORRECT ITERATION BLOCK BELOW FOR FIRST             */
/* ITERATION.EDIT AND SUBMIT IMAGE JCL.INCREMENT             */
/* ITERATION AND CHECK AGAINST FINAL ITERATION VALUE.        */
```

```
/* CONTINUE TO NEXT BLOCK, EXIT FROM MACRO.NOTE THAT    */
/* ITERATION 1 (ONLY USES) JCL THAT ACCESSES THE        */
/* INITIAL COAL RESERVES DATA FILE (NO ADVANCED BASIS), */
/* WHILE FOLLOWING INTERATIONS USE THE UPDATED DATA     */
/* PROVIDED BY THE PRECEDING ITERATION (WITH ADVANCED   */
/* BASIS).THE MACRO SUBMITS THE JOBS IN ORDER, BUT IF   */
/* THEY ARE EXECUTED IN THE QUEUE IN ANY OTHER ORDER,   */
/* ERRORS MAY OCCUR.                                    */
/*******************************************************/
/*                                                      */
NEXT:IF &S1 EQ 1 THEN GOTO IT01
 IF &S1 EQ 2 THEN GOTO IT02
 IF &S1 EQ 3 THEN GOTO IT03
 IF &S1 EQ 4 THEN GOTO IT04
 IF &S1 EQ 5 THEN GOTO IT05
 IF &S1 EQ 6 THEN GOTO IT06
 IF &S1 EQ 7 THEN GOTO IT07
 IF &S1 EQ 8 THEN GOTO IT08
 IF &S1 EQ 9 THEN GOTO IT09
 IF &S1 EQ 10 THEN GOTO IT10
IT01:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(NOADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COALIT01)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT00/ALL
 TOP
 CHANGE * 11000 /IT@@/IT01/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT02:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT01/ALL
 TOP
 CHANGE * 11000 /IT@@/IT02/ALL
```

```
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT03:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT02/ALL
 TOP
 CHANGE * 11000 /IT@@/IT03/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT04:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT03/ALL
 TOP
 CHANGE * 11000 /IT@@/IT04/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT05:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT04/ALL
 TOP
 CHANGE * 11000 /IT@@/IT05/ALL
 SUBMIT *
```

```
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT06:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT05/ALL
 TOP
 CHANGE * 11000 /IT@@/IT06/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT07:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT06/ALL
 TOP
 CHANGE * 11000 /IT@@/IT07/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT08:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT07/ALL
 TOP
 CHANGE * 11000 /IT@@/IT08/ALL
 SUBMIT *
 END NOSAVE
```

```
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT09:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT08/ALL
 TOP
 CHANGE * 11000 /IT@@/IT09/ALL
 SUBMIT *
 END NOSAVE
 SET &S1=&S1+1
 IF &S1 GT &S2 THEN GOTO ENDIT
IT10:QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WADBAS)'
 VERIFY OFF
 CHANGE * 300 /ZZZ/&STR(&S10)/ALL
 BOTTOM
 INCLUDE 'CPOASAI.JCL.COAL.RUNBK.PDS(COAL)' 2 278 NONUM
 TOP
 CHANGE * 11000 /SSSSSSSS/&STR(&S0)/ALL
 TOP
 CHANGE * 11000 /IT!!/IT09/ALL
 TOP
 CHANGE * 11000 /IT@@/IT10/ALL
 SUBMIT *
 END NOSAVE
ENDIT: EXIT
```

MACRO:MPMS2

```
/*************************************************************/
/*                                                           */
/* THIS MACRO MODIFIES AND SUBMITS THE JCL TO GENERATE       */
/* THE AUSM NATIONAL LOOP REPORTS FOR A SINGLE               */
/* CONVERGENCE ITERATION.THE MACRO PROMPTS FOR USER ID,      */
/* SCENARIO ID, AND ITERATION NUMBER.THESE DATA ARE          */
/* CHECKED FOR DATATYPE, LENGTH, AND RANGE.THE DATA ARE      */
/* ARE THEN SUBSTITUTED JCL AND SUBMITTED.THE MACRO          */
/* CHECKS FOR THE ITERATION VALUE STRING LENGTH OF 1         */
/* OR 2 (ITERATIONS 1-10) AND SUBSTITUTES ACCORDINGLY.       */
/* 1 OR 2 (1 -10) AND SUBSTITUTE ACCORDINGLY.                */
/*                                                           */
/*************************************************************/
/*
USER: WRITE ENTER YOUR 3-LETTER USER ID:
READ &S10
IF &DATATYPE(&S10)=CHAR AND &LENGTH(&S10)=3 THEN GOTO SCEN
WRITE ILLEGAL USER ID.
GOTO USER
SCEN: WRITE ENTER 1-8 LETTER SCENARIO ID:
READ &S0
SET &L = &LENGTH(&S0)
IF &DATATYPE(&S0)=CHAR AND &L>=1 AND &L<=8 THEN GOTO ITER
WRITE ILLEGAL SCENARIO ID:
GOTO SCEN
ITER: WRITE ENTER CONVERGENCE ITERATION # (1 - 10):
READ &S1
SET &L = &LENGTH(&S1)
IF &DATATYPE(&S1)=NUM AND &L>=0 AND &L<=10 THEN GOTO NEXT
WRITE ILLEGAL CONVERGENCE ITERATION #.
GOTO ITER
NEXT: QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(REPORTS)'
VERIFY OFF
CHANGE * 5100 'ZZZ' '&STR(&S10)' ALL
TOP
CHANGE * 5100 'SSSSSSSS' '&STR(&S0)' ALL
IF &S1>=10 THEN GOTO STEP10
TOP
CHANGE * 5100 'IT@@' 'IT0&STR(&S1)' ALL
GOTO STEP20
STEP10: TOP
CHANGE * 5100 'IT@@' 'IT&STR(&S1)' ALL
STEP20: SUBMIT *
END NOSAVE
```

```
RENAME 'CPOASAI.&STR(&S0).AUSM.E9.PDS(R03) +
'CPOASAI.&STR(&S0).AUSM.E9.PDS(R03OLD)
RENAME 'CPOASAI.&STR(&S0).AUSM.E9.PDS(R07) +
'CPOASAI.&STR(&S0).AUSM.E9.PDS(R07OLD)
QED 'CPOASAI.JCL.MPMS.RUNBK.PDS(WVNJXFER)'
VERIFY OFF
CHANGE * 5100 'ZZZ' '&STR(&S10)' ALL
TOP
CHANGE * 5100 'SSSSSSSS' '&STR(&S0)' ALL
SUBMIT *
END NOSAVE
EXIT
```

MACRO:AUSM1

```
/*************************************************************/
/*                                                           */
/* THIS MACRO FIRST GENERATES THE E5A FILE OF PLANNED         */
/* CAPACITY ADDITIONS AND THEN EXECUTES THE AUSM STATE        */
/* MODEL FOR EACH OF THE 13 REGIONS.THE MACRO FIRST           */
/* PROMPTS FOR USER ID AND SCENARIO ID, AND CHECKS            */
/* THESE DATA FOR DATATYPE AND LENGTH.THE JCL FOR THE         */
/* E5A GENERATION IS EDITED AND SUBMITTED.THE JCL FOR         */
/* THE STATE MODEL IS THEN SUBMITTED FOR EACH REGION IN       */
/* SUCCESSION.                                               */
/*                                                           */
/*************************************************************/
/*                                                           */
USER: WRITE ENTER YOUR 3-LETTER USER ID:
READ &S10
IF &DATATYPE(&S10)=CHAR AND &LENGTH(&S10)=3 THEN GOTO SCEN
WRITE ILLEGAL USER ID.
GOTO USER
SCEN: WRITE ENTER 1-8 LETTER SCENARIO ID:
READ &S0
SET &L=&LENGTH(&S0)
IF &DATATYPE(&S0)=CHAR AND &L>=1 AND &L<=8 THEN GOTO NEXT
GOTO SCEN
NEXT: QED 'CPOASAI.JCL.AUSM.RUNBK.PDS(E5AGENR)'
VERIFY OFF
CHANGE * 600 /ZZZ/&STR(&S10)/
TOP
CHANGE * 600 /SSSSSSSS/&STR(&S0)/ALL
SUBMIT *
END NOSAVE
QED 'CPOASAI.JCL.AUSM.RUNBK.PDS(STATEXEC)'
VERIFY OFF
TOP
CHANGE * 1500 /ZZZ/&STR(&S10)/
TOP
CHANGE * 1500 /SSSSSSSS/&STR(&S0)/ALL
SUBMIT *
TOP
CHANGE * 1500 /R01/R02/ALL
SUBMIT *
TOP
CHANGE * 1500 /R02/R03/ALL
SUBMIT *
TOP
```

```
CHANGE * 1500 /R03/R04/ALL
SUBMIT *
TOP
CHANGE * 1500 /R04/R05/ALL
SUBMIT *
TOP
CHANGE * 1500 /R05/R06/ALL
SUBMIT *
TOP
CHANGE * 1500 /R06/R07/ALL
SUBMIT *
TOP
CHANGE * 1500 /R07/R08/ALL
SUBMIT *
TOP
CHANGE * 1500 /R08/R09/ALL
SUBMIT *
TOP
CHANGE * 1500 /R09/R10/ALL
SUBMIT *
TOP
CHANGE * 1500 /R10/R11/ALL
SUBMIT *
TOP
CHANGE * 1500 /R11/R12/ALL
SUBMIT *
TOP
CHANGE * 1500 /R12/R13/ALL
SUBMIT *
END NOSAVE
EXIT
```

MACRO:AUSM2

```
/*************************************************************/
/*                                                           */
/* THIS MACRO MODIFIES AND SUBMITS THE JCL TO GENERATE       */
/* THE AUSM NATIONAL LOOP REPORTS USING SAS.                 */
/*                                                           */
/*************************************************************/
/*                                                           */
USER: WRITE ENTER YOUR 3-LETTER USER ID:
READ &S10
IF &DATATYPE(&S10)=CHAR AND &LENGTH(&S10)=3 THEN GOTO SCEN
WRITE ILLEGAL USER ID.
GOTO USER
SCEN: WRITE ENTER 1-8 LETTER SCENARIO ID:
READ &S0
SET &L = &LENGTH(&S0)
IF &DATATYPE(&S0)=CHAR AND &L>=1 AND &L<=8 THEN GOTO NEXT
WRITE ILLEGAL SCENARIO ID:
GOTO SCEN
NEXT: QED 'CPOASAI.JCL.AUSM.RUNBK.PDS(SASNAT)'
VERIFY OFF
CHANGE * 5100 'ZZZ' '&STR(&S10)'
TOP
CHANGE * 5100 'SSSSSSSS' '&STR(&S0)' ALL
IF &S1>=10 THEN GOTO STEP10
STEP20: SUBMIT * END NOSAVE
EXIT
```